

Patent Application
Docket Number: EMC-03-102
Applicant: Haase et al.
EMC CONFIDENTIAL
Express Mailing Label No EK900600596US

What is claimed is:

1. In a data storage environment having a first volume of data denominated as the source being stored on a data storage system, and a second volume of data denominated as the clone and which has data content that is a copy of the data content of the source being stored on the data storage system or on another data storage system, a method of recovering the clone's data content in a situation wherein an operation to restore the source is interrupted during restoration of data from a second volume of data to a first volume of data, the method comprising the steps of:

10 preserving the data content of the clone by not allowing it to be overwritten during restoration of the source, which restoration operation occurs when the data content of the source is replaced with the data content of the clone;

creating a persistent map denominated as a persistent protected restore map to track extents of the source that are modified during the restoring and preserving steps;

15 creating a persistent map denominated as a persistent clone delta map to track extents of the clone that may be different from the clone and the source; and

in response to an interruption of a restore operation of the source, using the persistent protected restore map and the persistent clone delta map to resume the restore operation that had been interrupted.

20

2. The method of claim 1, wherein the source and the clone are each represented by respective first and second logical units.

3. The method of claim 1, wherein a map denominated as a protected restore map is used to track extents of the source that are modified during the preserving step.

5 4. The method of claim 1, wherein a map denominated as a clone delta map is used to track extents of the clone that may be different from the clone and the source.

5. The method of claim 2, wherein a map denominated as a protected restore map is used to track extents of the source that are modified during the preserving step.

10

6. The method of claim 5, wherein the clone delta map is used to copy only extents that are different between the clone and its source during restoring of the source.

15 7. The method of claim 6, wherein the protected restore map is coordinated with the clone delta map for efficient processing of requests to write data to the source.

8. A system for recovering the data content in a situation wherein an operation to restore data is interrupted during restoration of data from a second volume of data to a first volume of data, the system comprising:

20 a data storage system having a first volume of data denominated as the source being stored on a data storage system, and a second volume of data denominated as the

clone and which has data content that is a copy of the data content of the source being stored on the data storage system or on another data storage system;

computer-executable program logic configured for causing the following computer-executed steps to occur:

5 preserving the data content of the clone by not allowing it to be overwritten during restoration of the source, which restoration operation occurs when the data content of the source is replaced with the data content of the clone;

10 creating a persistent map denominated as a persistent protected restore map to track extents of the source that are modified during the restoring and preserving steps;

15 creating a persistent map denominated as a persistent clone delta map to track extents of the clone that may be different from the clone and the source; and

20 in response to an interruption of a restore operation of the source, using the persistent protected restore map and the persistent clone delta map to resume the restore operation that had been interrupted.

9. The system of claim 8, wherein the source and the clone are each represented by respective first and second logical units.

20 10. The system of claim 8, wherein a map denominated as a protected restore map is used to track extents of the source that are modified during the restoring and preserving steps.

11. The system of claim 8, wherein a map denominated as a clone delta map is used to track extents of the clone that may be different from the clone and the source.

5 12. The system of claim 9, wherein a map denominated as a protected restore map is used to track extents of the source that are modified during the restoring and preserving step.

10 13. The system of claim 12, wherein the clone delta map is used to copy only extents that are different between the clone and its source during the restoring step.

14. The system of claim 13, wherein the protected restore map is coordinated with the clone delta map for efficient processing of requests to write data to the source.

15 15. A program product for use in a data storage environment and being for recovering the data content in a situation wherein an operation to restore data is interrupted during of data from a second volume of data to a first volume of data, wherein the data storage environment includes:

20 a data storage system having a first volume of data denominated as the source being stored on a data storage system, and a second volume of data denominated as the clone and which has data content that is a copy of the data content of the source being stored on the data storage system or on another data storage system; and-

Patent Application
Docket Number: EMC-03-102
Applicant: Haase et al.
EMC CONFIDENTIAL
Express Mailing Label No EK900600596US

the program product includes computer-executable logic contained on a computer-readable medium and which is configured for causing the following computer-executed step to occur:

preserving the data content of the clone by not allowing it to be overwritten

- 5 during restoration of the source, which restoration operation occurs when the data content of the source is replaced with the data content of the clone;

creating a persistent map denominated as a persistent protected restore map to track extents of the source that are modified during the restoring and preserving steps;

creating a persistent map denominated as a persistent clone delta map to track

- 10 extents of the clone that may be different from the clone and the source; and

in response to an interruption of a restore operation of the source, using the persistent protected restore map and the persistent clone delta map to resume the restore operation that had been interrupted.

- 15 16. The program product of claim 15, wherein the source and the clone are each represented by respective first and second logical units.

17. The program product of claim 15, wherein a map denominated as a protected restore map is used to track extents of the source that are modified during the restoring and preserving steps.

Patent Application
Docket Number: EMC-03-102
Applicant: Haase et al.
EMC CONFIDENTIAL
Express Mailing Label No EK900600596US

18. The program product of claim 15, wherein a map denominated as a clone delta map is used to track extents of the clone that may be different from the clone and the source.

5 19. The program product of claim 16, wherein a map denominated as a protected restore map is used to track extents of the source that are modified during the restoring and preserving step.

10 20. The program product of claim 19, wherein the clone delta map is used to copy only extents that are different between the clone and its source during the restoring step.

21. The program product of claim 20, wherein the protected restore map is coordinated with the clone delta map for efficient processing of requests to write data to the source.